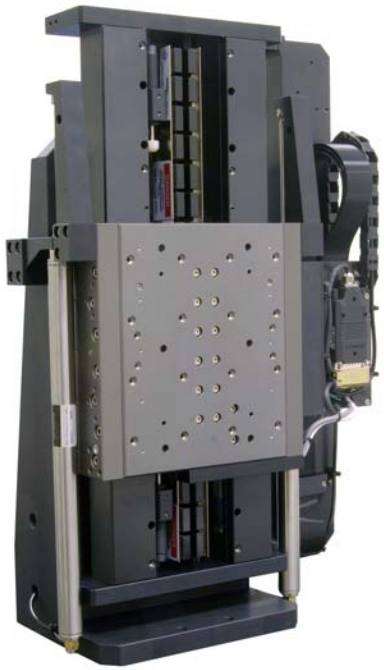
ABL1500Z Series Stage
User's Manual

P/N: EDS130 (Revision 1.02.00)



Dedicated to the Science of Motion

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Chapter 1: Overview

This manual describes Aerotech's ABL1500Z series of air bearing positioning stages. Figure 1-1 shows a typical ABL1500Z positioning stage.

The ABL1500Z series supports travel distances ranging from 50 mm to 200 mm (2 in to 8 in). The ABL1500Z combines excellent pitch/yaw characteristics with the unsurpassed velocity control that is necessary for printing, imaging, and fiber-optic applications.

This chapter introduces standard and optional features of the ABL1500Z stages and gives general safety precautions.

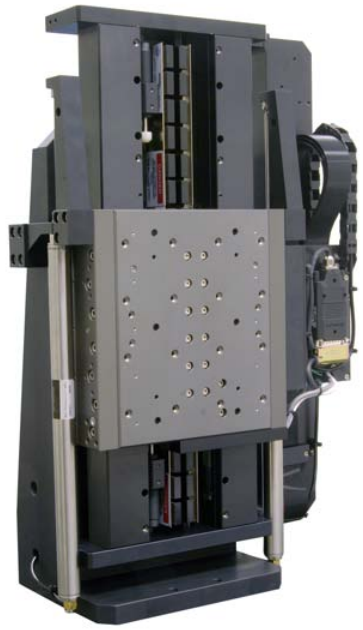


Figure 1-1: Typical ABL1500Z Series Linear Positioning Stage

NOTE: Aerotech continually improves its product offerings, and listed options may be superseded at any time. Refer to the most recent edition of the Aerotech Motion Control Product Guide for the most current product information at www.aerotech.com.

1.1. Standard Features

The ABL1500Z series stages all incorporate completely non-contact air bearing surfaces, linear motors, and feedback devices to provide a maintenance free stage. There is no mechanical contact to wear or require lubrication, making these stages ideal for clean room and medical applications.

The ABL1500Z incorporates air-on-air preload on both vertical and horizontal surfaces. The opposing thin-film pressure maintains the bearing nominal gap tolerance. This design, in addition to the large air-bearing surface that distributes the load over a large surface area, results in a stage with outstanding stiffness that is ideal for heavy or offset loading.

The non-contact pneumatic counterbalance cylinders coupled with a precision regulator allow for a broad range of loading with minimal counterbalance setup.

The brushless linear motor uses an ironless forcer, which means there is zero cogging and no attractive forces – resulting in unsurpassed smoothness of motion. This is especially useful in applications where velocity control is important.

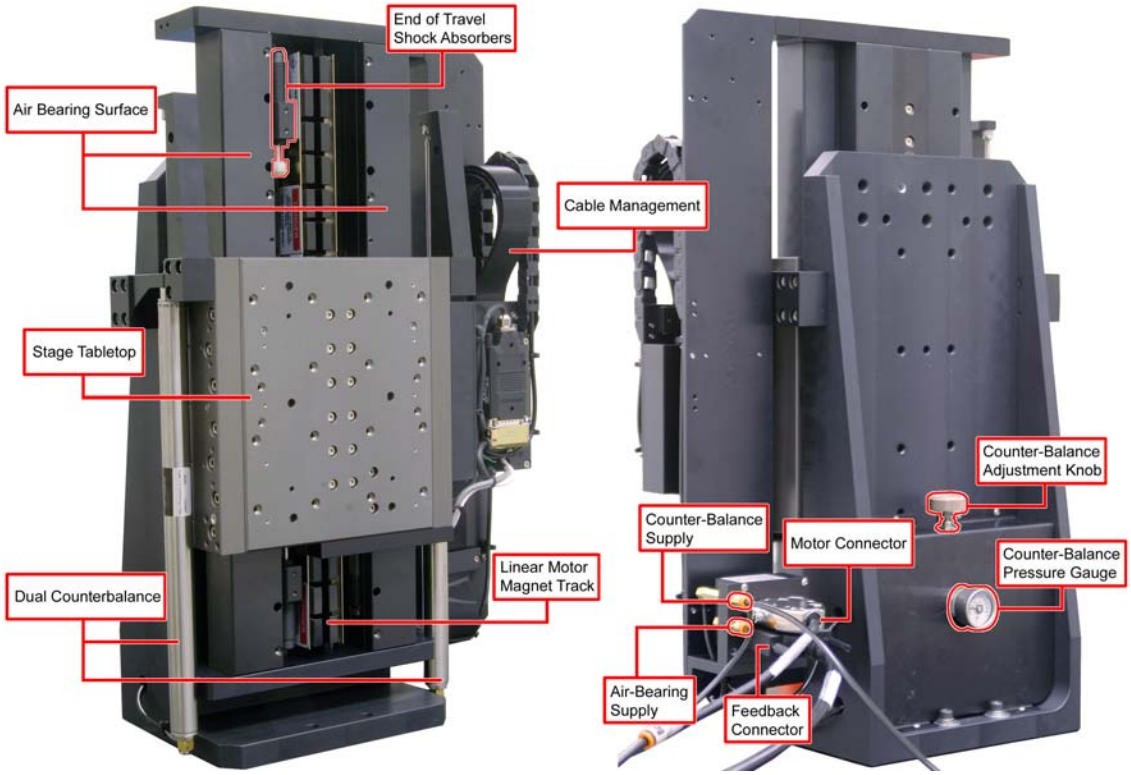


Figure 1-2: ABL1500Z Series Stage

1.1.1. Optional Features

The ABL1500Z can be readily customized to meet the needs of individual applications. Common examples include cable management for stage-mounted payloads, custom tabletops, and granite bases. Contact the Aerotech factory for more details.

Table 1-1: Ordering Example (ABL15010Z-M-10-NC-LN10AS-SINGLE-CMS)

Series	Travel (mm)	Mounting and Grid Pattern	Motor	Limits	Linear Encoder	Options
ABL15	010Z	-M	-10	-NC	-LN10AS	-SINGLE-CMS

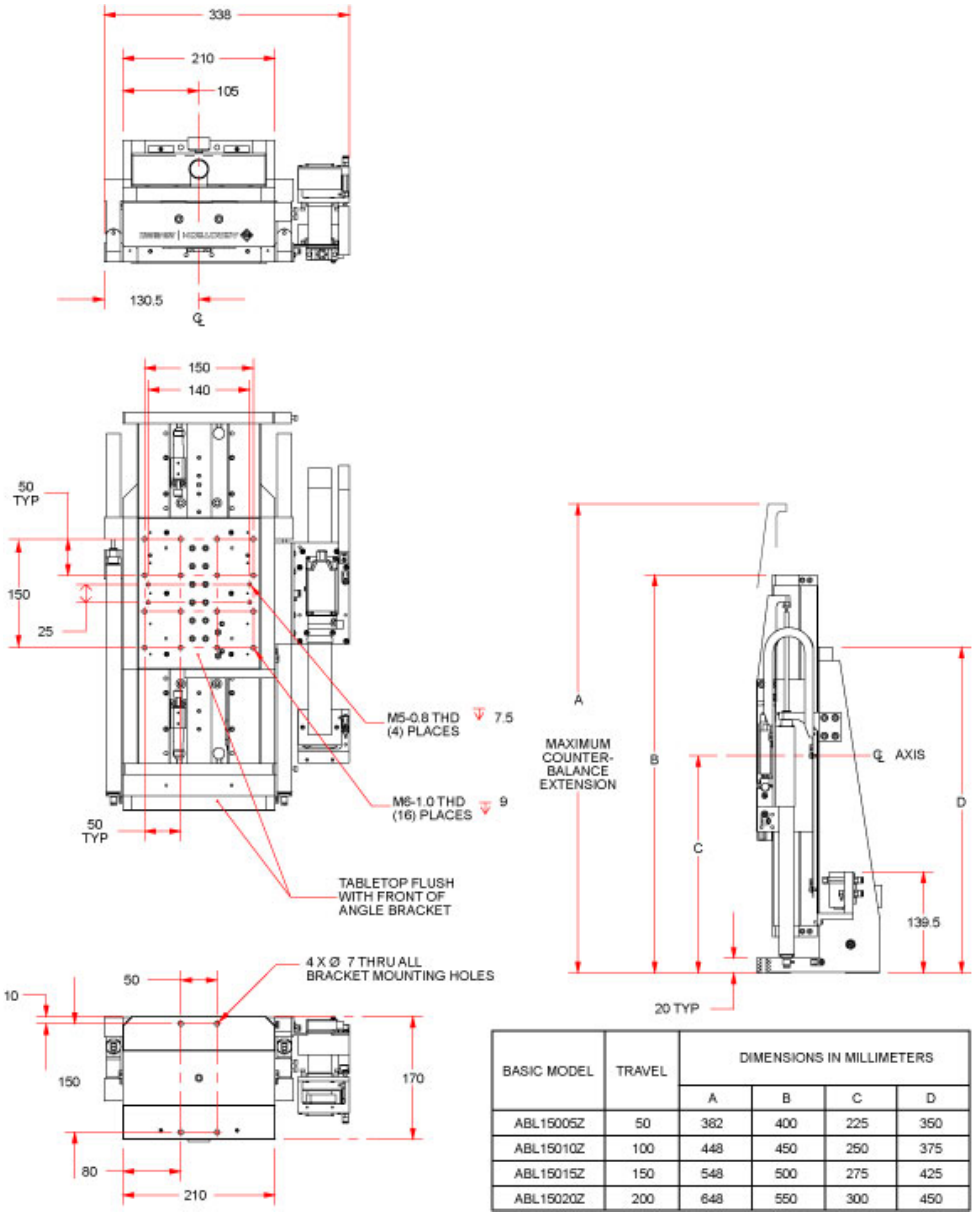
Table 1-2: Model Numbers and Ordering Options

ABL1500 Series Linear Air Bearing Stage	
ABL15005Z	50 mm (2 in) travel
ABL15010Z	100 mm (4 in) travel
ABL15015Z	150 mm (6 in) travel
ABL15020Z	200 mm (8 in) travel
Mounting and Grid Pattern	
-M	Metric dimension mounting pattern and holes
Motor	
-10	Brushless linear motor (BLMC-192-A)
Limits	
-NC	Normally-closed end of travel limit switches (standard)
Standard Linear Encoders	
-LT05AS	Linear encoder for ABL15005Z; amplified sine output
-LT10AS	Linear encoder for ABL15010Z; amplified sine output
-LT15AS	Linear encoder for ABL15015Z; amplified sine output
-LT20AS	Linear encoder for ABL15020Z; amplified sine output
-LT05X50	Linear encoder for ABL15005Z; 0.1 micron line driver output
-LT10X50	Linear encoder for ABL15010Z; 0.1 micron line driver output
-LT15X50	Linear encoder for ABL15015Z; 0.1 micron line driver output
-LT20X50	LInear encoder for ABL15020Z; 0.1 micron line driver output

Table 1-2: Ordering Options (continued)

High-Accuracy Linear Encoders	
-LN05AS	High-accuracy linear encoder for ABL15005Z; amplified sine output
-LN10AS	High-accuracy linear encoder for ABL15010Z; amplified sine output
-LN15AS	High-accuracy linear encoder for ABL15015Z; amplified sine output
-LN20AS	High-accuracy linear encoder for ABL15020Z; amplified sine output
Options	
-SINGLE-CMS	Cable management system for single axis applications
-Z-CMS	Cable management system for Y-Z assembly
Accessories (to be ordered as separate line item)	
HALAR	High-accuracy system; linear error correction for accuracy and repeatability
ALIGNMENT-PA5Z	YZ assembly; 5 arc-seconds or 3 microns/full travel, whichever is larger
ALIGNMENT-PA10Z	YZ assembly; 10 arc-seconds or 7 microns/full travel, whichever is larger

1.2. Dimensions



BASIC MODEL	TRAVEL	DIMENSIONS IN MILLIMETERS			
		A	B	C	D
ABL15005Z	50	382	400	225	350
ABL15010Z	100	448	450	250	375
ABL15015Z	150	548	500	275	425
ABL15020Z	200	648	550	300	450

Figure 1-3: ABL1500Z Series Stage Dimensions

1.3. Safety Procedures and Warnings

The following statements apply throughout this manual. Failure to observe these precautions could result in serious injury to those performing the procedures and damage to the equipment.

This manual and any additional instructions included with the stage should be retained for the lifetime of the stage.

	To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.
	To minimize the possibility of electrical shock and bodily injury or death when any electrical circuit is in use, ensure that no person comes in contact with the circuitry when the stage is connected to a power source.
	To minimize the possibility of bodily injury or death, disconnect all electrical power prior to making any mechanical adjustments.
	Moving parts of the stage can cause crushing or shearing injuries. All personnel must remain clear of any moving parts.
	Improper use of the stage can cause damage, shock, injury, or death. Read and understand this manual before operating the stage.
	If the stage is used in a manner not specified by the manufacturer, the protection provided by the stage can be impaired.
	Stage cables can pose a tripping hazard. Securely mount and position all stage cables to avoid potential hazards.

Do not expose the stage to environments or conditions outside the specified range of operating environments. Operation in conditions other than those specified can cause damage to the equipment.

The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.

Use care when moving the stage. Manually lifting or transporting stages can result in injury.

Only trained personnel should operate, inspect, and maintain the stage.

This stage is intended for light industrial manufacturing or laboratory use. Use of the stage for unintended applications can result in injury and damage to the equipment.

Before using this stage, perform an operator risk assessment to determine the needed safety requirements.

1.4. EC Declaration of Incorporation

Manufactorer: Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238
USA

herewith declares that the product:
Aerotech, Inc. ABL1500Z Stage
is intended to be incorporated into machinery to constitute machinery covered by the Directive 2006/42/EC as amended;

does therefore not in every respect comply with the provisions of this directive;

and that the following harmonized European standards have been applied:
EN ISO 12100-1,-2:2003+A1:2009
Safety of machinery - Basic concepts, general principles for design
ISO 14121-1:2007
Safety of machinery - Risk assessment - Par 1: Principles
EN 60204-1:2005
Safety of machinery - Electrical equipment of machines - Part 1: General requirements
and further more declares that
it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, i.e. as a whole, including the equipment referred to in this Declaration.

Authorized Representative: Manfred Besold
Address: AEROTECH GmbH
Süd-West-Park 90
D-90449 Nürnberg

Name: Alex Weibel /
Position: Engineer Verifying Compliance
Location: Pittsburgh, PA
Date: April 15, 2011

Chapter 2: Installation

This chapter describes the installation procedure the ABL1500Z stage, including handling the stage properly, securing the stage to the mounting surface, attaching the payload, adjusting the counterbalance, and making the electrical connections.

Installation must follow the instructions in this chapter. Failure to follow these instructions could result in injury and damage to the equipment.

2.1. Unpacking and Handling the Stage

Carefully remove the stage from the protective shipping container. Before operating the stage, it is important to let the stage to stabilize at room temperature for at least 12 hours. Clean the stage by blowing it off with pressurized nitrogen or clean, oil-less air.

ABL1500Z stages come equipped with a red-anodized angle bracket and eyebolts attached to the stage as shown in Figure 2-1. Use these in conjunction with lifting straps.Do not attempt to lift or move the stage by the table, cable brackets, or end plates. For multi-axis assemblies, always lift the system by the lower axis. Lifting by the upper axis may disturb precision alignments on the system.

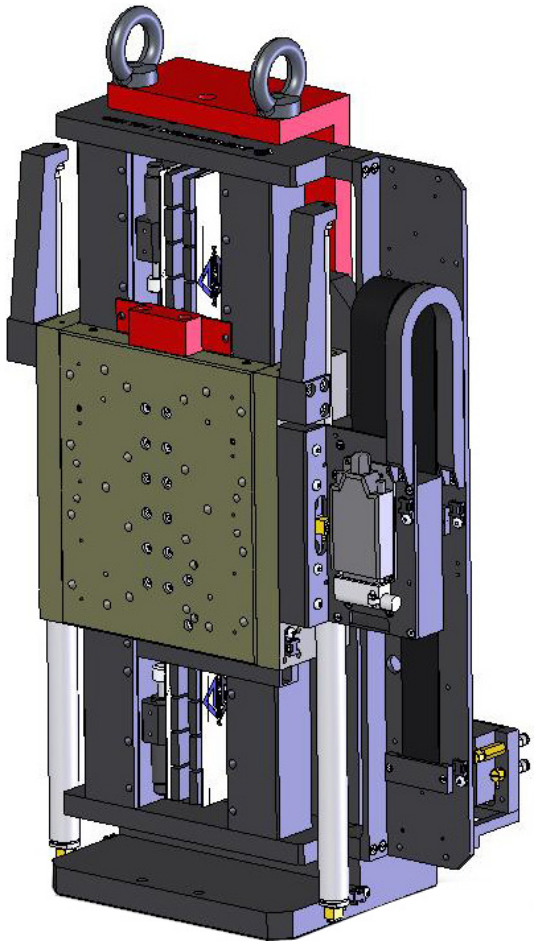


Figure 2-1: Lifting Features

Each stage has a label listing the system part number and serial number. These numbers contain information necessary for maintaining or updating system hardware and software. Locate this label and record the information for later reference. If any damage has occurred during shipping, report it immediately.

Improper stage handling could adversely affect the stage's performance. Use care when moving the stage. Manually lifting or transporting stages can result in injury.

Do not attempt to move the stage until the air supply, detailed inSection 2.6. , has been installed. Moving the stage table without air supplied can cause permanent damage to the stage.

2.2. Preparing the Mounting Surface

The mounting surface should be flat and have adequate stiffness in order to achieve the maximum performance from the ABL1500Z. When an ABL1500Z series stage is mounted to a non-flat surface, the angle bracket can be distorted as the mounting screws are tightened. This distortion will decrease the overall accuracy of the stage. Adjustments to the mounting surface must be done before the stage is secured.

NOTE: To maintain accuracy, the mounting surface should be flat within 1 µm per 150 mm.

NOTE: The Z-Axis angle bracket is precision machined and verified for flatness prior to stage assembly at the factory. If machining is required to achieve the desired flatness, it should be performed on the mounting surface rather than the stage base. Shimming should be avoided if possible. If shimming is required, it should be minimized to improve the rigidity of the system.

2.3. Securing the Stage to the Mounting Surface

Strong rare-earth magnets are present in the linear motor magnet track. Loose metal objects (tools, watches, keys, etc.) can cause personal injury or damage to the equipment.

The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.

Procedure for ABL1500Z mounting:

1. Prepare the mounting surface and bottom mounting pads of the angle bracket with precision flatstones to remove any burrs or high spots.
2. Clean the mounting surface and bottom of the angle bracket with the appropriate cleaners (acetone or iso-propyl alcohol for the angle bracket).
3. Place the stage on the mounting surface
4. Tighten the four mounting screws (Figure Figure 2-2). The typical torque value for M6 socket head cap screws is 8 N-m.
5. Remove the lifting bracket from the back of the stage assembly (if shipped as a single axis). The lifting bracket is mounted to the stage with M8-1.25x20mm socket head cap screws.

Do not attempt to move the stage until the air supply, detailed in Section 2.6. , has been installed. Moving the stage table without air supplied can cause permanent damage to the stage.

6.

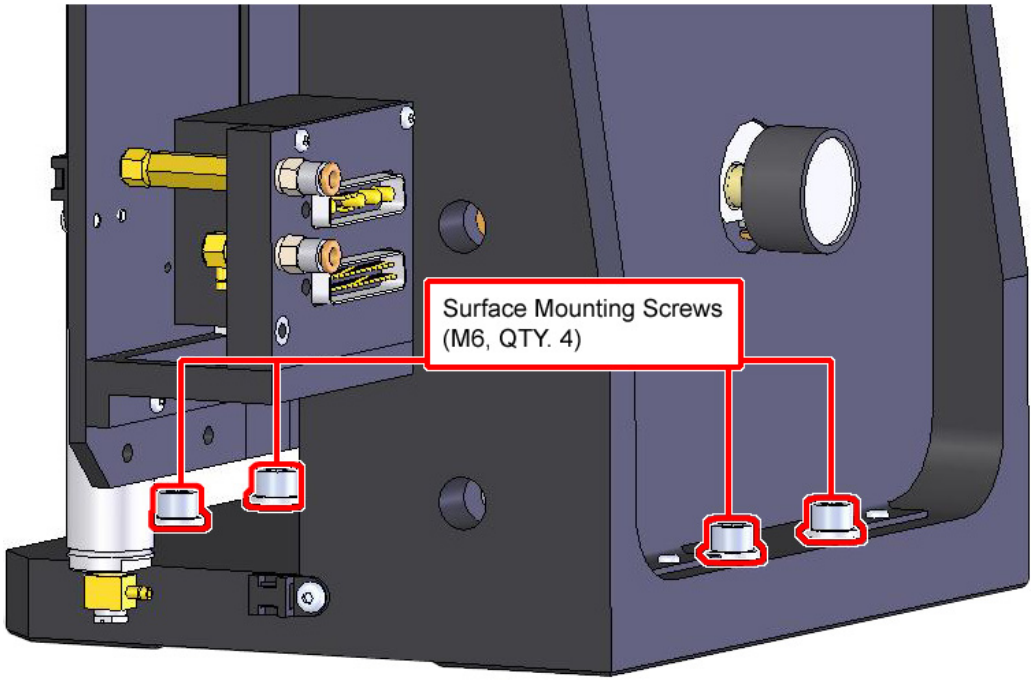


Figure 2-2: Surface Mounting Screws

2.4. Setting Up the Pneumatic Counterbalance

Failure to adjust the counterbalance per the following instructions could result in bodily injury as well as stage and payload damage.

Sudden loss of pressure to the pneumatic counterbalance will cause the carriage to drop rapidly. This could result in bodily injury as well as stage and payload damage.

By default, the ABL1500Z pneumatic counterbalances are factory set to operate in the as-shipped condition. For stages that are shipped unloaded, the counterbalance is set for the mass of the carriage only. For stages that ship with payloads or other axes attached, the counterbalance is set for the mass of the carriage plus the additional mass. Any adjustment to the mass that is carried by the counterbalance cylinders, either adding or subtracting payload, necessitates an adjustment to the counterbalance pressure supplied to the pneumatic cylinders.

Standard ABL1500Z stages have two counterbalance cylinders with a combined piston area of 3.79x10-4 m2, and the moving mass of a standard ABL1500Z carriage assembly is 5.9kg (13.1lb). An estimate of the counterbalance pressure required to support additional load is given by the following:

$$Pc = ((mp + 5.9) * 9.81) / (3.79e\text{-}4) / 1e6 \{MPa\}$$

where

Pc = Required counterbalance pressure in MPa (maximum 0.6MPa allowed)

mp = mass of external payload in kg.

This relationship is shown graphically in Figure 2-3.

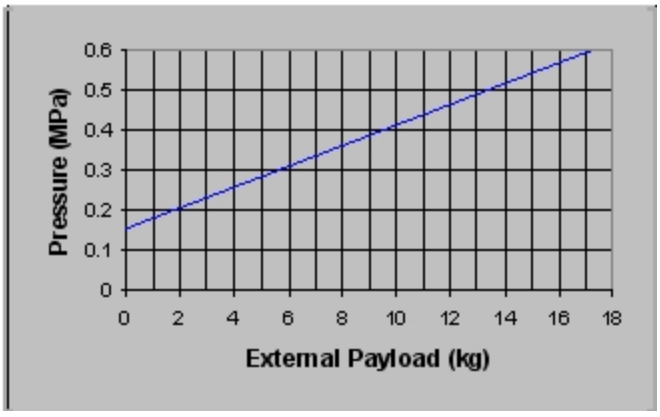


Figure 2-3: Counterbalance Pressure vs. External Payload

Procedure for initial pneumatic counterbalance setup:

1. Prior to removing the shipping bracket, connect the air lines to the air bearing and pneumatic counterbalance stage fittings (2.4).

NOTE: Refer to Section 2.6. or air requirements for both the air bearing and the pneumatic counterbalance. Be sure air supply meets specifications prior to continuing.

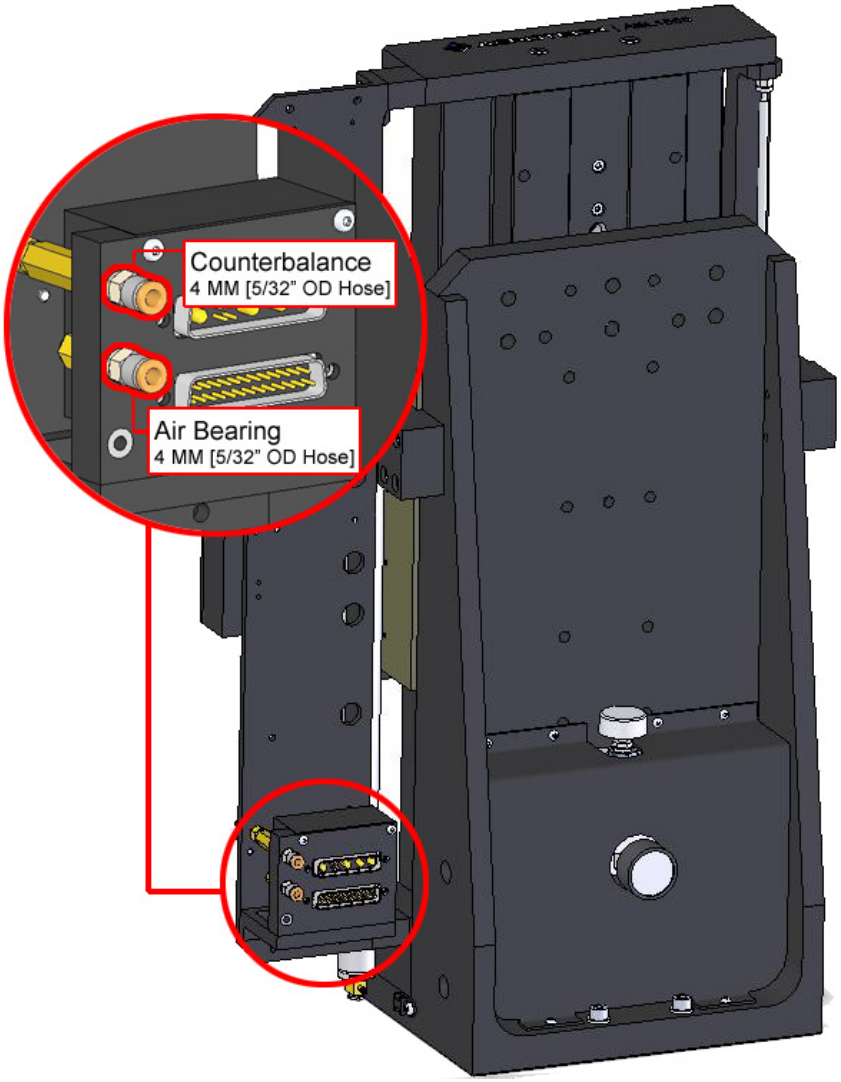


Figure 2-4: Connections for Air Bearing and Counterbalance

2. Turn on the air supply to both the air bearing stage and the pneumatic counterbalance. The pressure supply to the counterbalance fitting must exceed the pressure determined by Figure 2-3.
3. Loosen, but do not remove, the two M5-0.8x25mm socket head cap screws mounting the shipping bracket to the end of the carriage (Figure 2-5). Loosen the screws by two to three turns (1.6mm to 2.4mm).

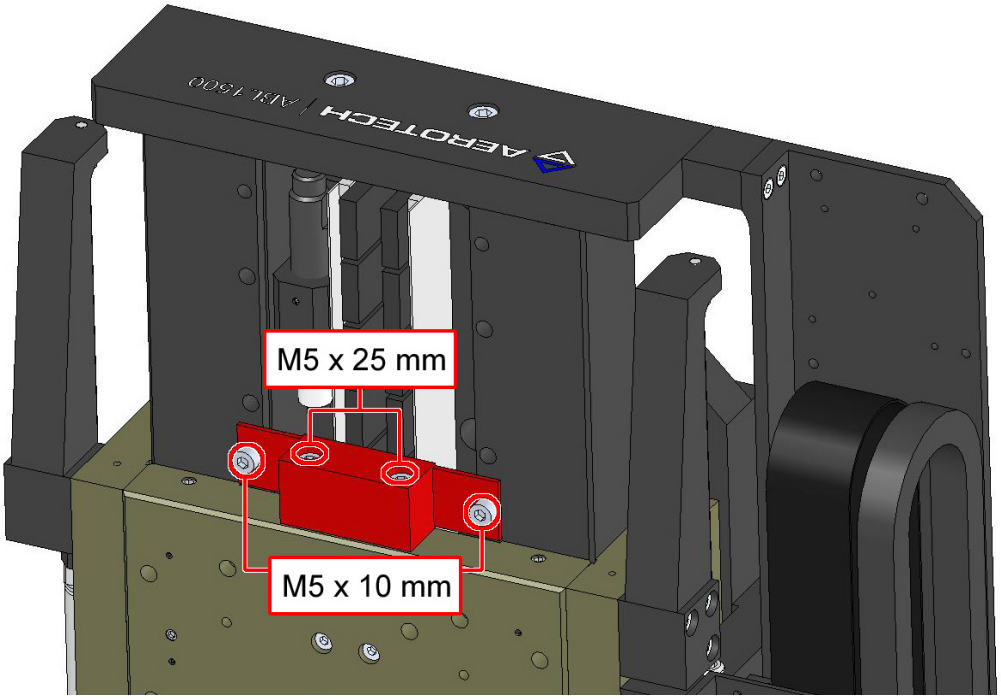


Figure 2-5: Shipping Bracket

4. By hand, move the carriage gently up and down. The carriage should move with little effort within the play of the loosened screws. If the counterbalance pressure is not high enough, the carriage will be hanging from the shipping bracket screws and will be hard to lift. If the counterbalance pressure is too high, the carriage will be pushing up against the shipping bracket and will be hard to pull down.

   a. If the counterbalance pressure seems to low, check the supply pressure to the input fitting prior to adjusting the factory setting of the regulator. Increase the supply pressure to the fitting until the pressure gauge on the back of the stage does not show a corresponding increase in pressure. Check the counterbalance of the carriage again.

   b. To adjust the pressure to the cylinders, place one hand on the carriage with the shipping brackets still loose and slowly turn the regulator knob. Clockwise rotation increases pressure, and counterclockwise rotation decreases pressure. Adjust the pressure until the carriage mass is balanced by the cylinders.

5. Once the cylinders are balanced, remove the M5x25mm shipping bracket screws from the end of the carriage.
6. Remove the shipping bracket from the base (M5x10mm socket head cap screws). Retain the shipping bracket for future use.

To turn off the air supply to the stage once the shipping brackets have been removed:

1. Make sure the stage is not under servo control.
2. Gently push the carriage down to the bottom of travel until the mechanical shock engages.
3. Gently push the stage down through the shock stroke until the shock bottoms out and hold the carriage in this position.
4. Turn off the counterbalance pressure. Once the counterbalance pressure has completely bled out, release the hand pressure on the carriage.
5. Turn off the air bearing supply

To change the payload on the stage (add or remove mass):

1. Follow the steps above for turning off the air to the stage
2. Turn the regulator knob on the back of the angle bracket counterclockwise until it bottoms out (prevents any pressure from reaching the cylinders).
3. Change the payload as required. See Section 2.7. for payload flatness requirement and Section 3.4. for loading charts.
4. Estimate the pressure required to lift the payload using Figure 2-3
5. Turn on the air supply to the air bearing
6. Turn on the air supply to the counterbalance input
7. Gradually increase the pressure to the cylinders with the precision regulator on the back of the angle bracket. Make fine adjustments when approaching the estimated pressure required for counterbalance. Adjust until the payload does not rise or fall when put into a position by hand.

2.5. Electrical Installation

Aerotech motion control systems are adjusted at the factory for optimum performance. When the ABL1500Z series stage is part of a complete Aerotech motion control system, setup involves connecting a stage to the appropriate drive chassis with the cables provided. Connect the provided cables to the feedback and motor connectors shown in Figure 2-6. Labels on the drive indicate the appropriate connections. Refer to your drive manuals and documentation for additional installation and operation information. In some cases, if the system is uniquely configured, a drawing showing system interconnects is supplied.

See Section 3.6. for standard wiring pinouts.

Never connect or disconnect any electrical component or connecting cable while power is applied, or serious damage may result.

The stage's protective ground is located in pin A4 of the motor connector. If you are using cables other than those provided by Aerotech, you must connect pin A4 to a ground connection.

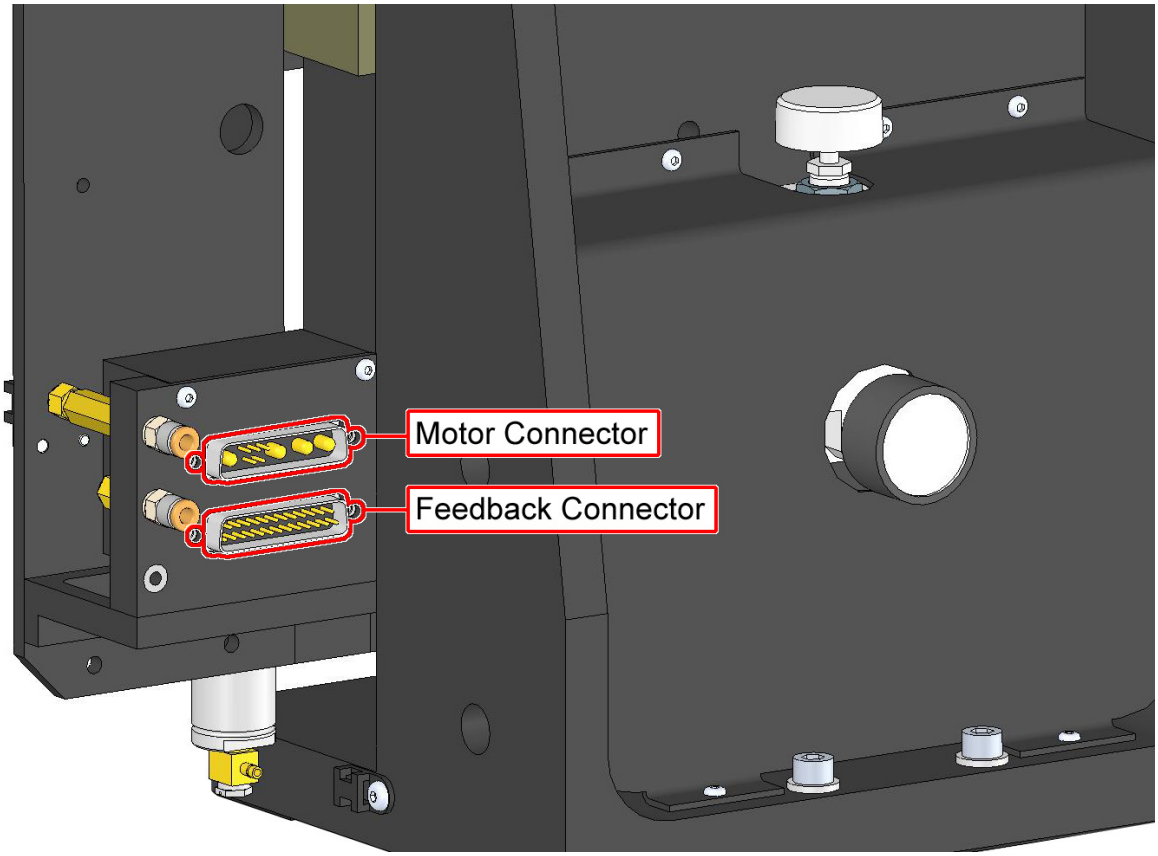


Figure 2-6: Motor and Feedback Connections

2.6. Air Requirements

The air supply to the air bearing and pneumatic counterbalance is important for the operation of the system. If compressed air is used, it must be filtered to 0.25 microns, dry to 0ºF dew point, and oil free. If nitrogen is used, it must be 99.99% pure and filtered to 0.25 microns. The filtration requirement is to prevent particles from clogging the air bearing and the pneumatic cylinders. For the air bearing, air pressure in the range of 517 kPa to 551 kPa (75 psi to 80 psi), is necessary for use. The pneumatic counterbalance pressure supply is determined by the amount of payload carried by the stage (Figure 2-3).

2.4 shows the location of the air fittings. Air should be supplied via 4 mm (5/32”) polyurethane air hoses.

For the air bearing, an airflow rate of between 24 to 30 SLPM (standard liters per minute) at 551 kPa should be observed (single axis). The air flow to the cylinders is dependent the pressure to the cylinders (Figure 2-7).

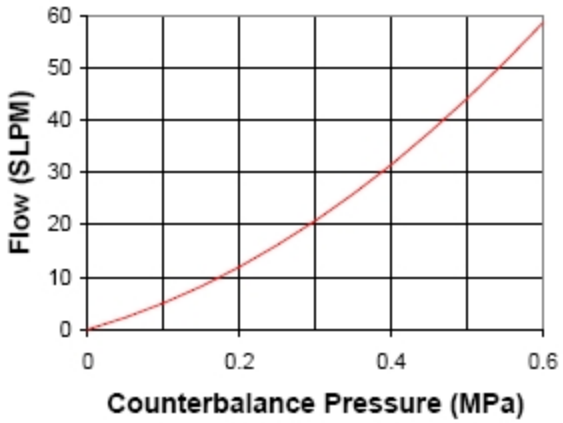


Figure 2-7: Counterbalance Air Flow vs. Counterbalance Pressure

2.7. Attaching the Payload to the Stage

To prevent damage to payloads, test the operation of the stage before the payload is attached to the stage table. .Proceed with the pneumatic counterbalance setup and the electrical installation first. Then test the motion control system in accordance with the system documentation. Document all results for future reference. For information on electrical connections, refer to the Section 2.5. and the documentation delivered with the stage.

The payload should be flat, rigid, and comparable to the stage in quality.

NOTE: For valid system performance, the mounting interface should be flat within 1 µm per 50 mm.

Chapter 3: Operating Specifications

The surrounding environment and operating conditions can affect the performance and service life of the stage. This chapter provides information on ideal environmental and instructions for estimating load capability.

3.1. Environmental Specifications

The environmental specifications for the ABL1500Z are listed in the following table.

Table 3-1: Environmental Specifications

Ambient Temperature	Operating: 16° to 25° C (61° to 77° F) The optimal operating temperature is 20° C ±2° C (68° F ±4° F). If at any time the operating temperature deviates from 20° C degradation in performance could occur. Contact Aerotech for information regarding your specific application and environment.
	Storage: 0° to 40° C (32° to 104° F) in original shipping packaging
Humidity	Operating: 40 percent to 60 percent RH The optimal operating humidity is 50 percent RH.
	Storage: 30 percent to 60 percent RH, non-condensing in original packaging
Altitude	Operating: 0 to 2,000 m (0 to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
Vibration	Use the system in a low vibration environment. Excessive floor or acoustical vibration can affect stage and system performance. Contact Aerotech for information regarding your specific application.
Dust Exposure	The ABL1500Z stages are not suited for dusty or wet environments. This equates to an ingress protection rating of IP00.
Use	Indoor use only

Do not expose the stage to environments or conditions outside the specified range of operating environments. Operation in conditions other than those specified can cause damage to the equipment.

3.2. Accuracy and Temperature Effects

Due to the small clearances in the air bearing design, extreme temperature environments could cause a decrease in performance or permanent damage to the stage. Standard Aerotech air-bearing stages are designed for and built in a 20°C (68°F) environment.

Stage travel changes linearly with temperature. The thermal expansion coefficient for standard ABL1500Z stages is 7.5 ppm per °C.

3.3. Basic Specifications

For the most recent specifications, see Aerotech's website.

Table 3-2: ABL1500Z Series Specifications

Basic Model			ABL15005Z	ABL15010Z	ABL15015Z	ABL15020Z
Travel			50 mm (2 in)	100 mm (4 in)	200 mm (8 in)	200 mm (8in)
Accuracy (1)	LN	HALAR	±0.2 µm (±8 µin)	±0.2 µm (±8 µin)	±0.3 µm (±20 µin)	±0.5 µm (±20 µin)
		Standard	±1.5 µm (±40 µin)	±2.5 µm (±80 µin)	±4 µm (±200 µin)	±6 µm (±200 µin)
	LT	HALAR	±0.3 µm (±12 µin)	±0.3 µm (±12 µin)	±0.4 µm (±20 µin)	±0.5 µm (±20 µin)
		Standard	±2 µm (±80 µin)	±4 µm (±160 µin)	±5 µm (±320 µin)	±8 µm (±320 µin)
Repeat-ability (Bi-Directional) (1)	LN		±0.1 µm (±4 µin)	±0.1 µm (±4 µin)	±0.15 µm (±8 µin)	±0.2 µm (±8 µin)
	LT		±0.1 µm (±4 µin)	±0.1 µm (±4 µin)	±0.15 µm (±8 µin)	±0.2 µm (±8 µin)
Straightness (1)			±0.4 µm (±16 µin)	±0.6 µm (±24 µin)	±0.8 µm (±32 µin)	±1.0 µm (±32 µin)
Flatness (1)			±0.4 µm (±16 µin)	±0.6 µm (±24 µin)	±0.8 µm (±32 µin)	±1.0 µm (±32 µin)
Pitch			±1.0 arc sec	±1.5 arc sec	±2.0 arc sec	±2.0 arc sec
Roll			±1.0 arc sec	±1.5 arc sec	±2.0 arc sec	±2.0 arc sec
Yaw			±1.0 arc sec	±1.5 arc sec	±2.0 arc sec	±2.0 arc sec
Maximum Speed			2.0 m/s (78.7 in/s)			
Maximum Acceleration			2 g – 20 m/s2 (768 in/s2) (no load)			
Maximum Force (Continuous)			93.6 N (21.0 lb)			
Load Capacity(2)			15.0 kg (33.1 lb)			
Operating Pressure			80 psi (5.5 bar) ±5 psig (0.3 bar)			
Air Consumption			Stage: 24 - 30 slpm @ 551 kPa; Counterbalance: 60slpm maximum			
Moving Mass (no load)			5.1 kg (11.2 lb)			
Stage Mass			23.8 kg (52.5 lb)	26.6 kg (58.6 lb)	28.5 kg (62.8 lb)	30.5 kg (67.2 lb)
Material			Aluminum			
Mean Time Between Failure			20,000 Hours			

(1) Certified with each stage.
(2) Axis orientation for on-axis loading is listed.
(3) Specifications are for single-axis systems measured 25 mm above the tabletop. Performance of multi-axis systems is payload and workpoint dependent. Consult factory for multi-axis or non-standard applications.
(4) To protect air bearing against under-pressure, an in-line pressure switch tied to the motion controller/amplifier ESTOP input is recommended.
(5) Air supply must be clean, dry to 0° F dewpoint and filtered to 0.25 µm or better; recommend nitrogen at 99.9% purity.
(6) Maximum upper axis length is 200 mm when mounting the ABL1500 in an XY configuration.

Table 3-3: ABL1500Z Series Resolution Information

Code	Signal Period	Travel/Step	Multiplier
LTAS	20 µm	0.005 µm - 1.0 µm	Requires External
LTX50	20 µm	0.1 µm	Integral x50
LN	4 µm	0.001 µm - 0.2 µm	Requires External

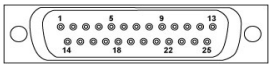
Code	Maximum Speed	Signal Type	Encoder Connector
LTAS	System Data Rate (up to 2.0 m/s)		
LTX50	1 m/s max		
LN	System Data Rate (up to 1.2 m/s)		
1. Requires system data rate of at least 14 MHz			

Table 3-4: ABL1500Z Series Motor Specifications

Model		BLMC-192
Winding Designation		-A
Performance Specifications (1,5)		
Continuous Force, 20 psi, 1.4 bar (2)	N	154.7
	lb	34.8
Continuous Force, No Cooling, (2)	N	106.7
	lb	24.0
Peak Force (3)	N	618.8
	lb	139.1
Electrical Specifications (5)		
BEMF Constant (line to line, max)	V / m / sec	30.66
	V / in / sec	0.78
Continuous Current, 20 psi, 1.4 bar (2)	A, pk	5.80
	A, rms	4.10
Continuous Current, No Cooling (2)	A, pk	4.00
	A, rms	2.83
Peak Current, Stall (3)	A, pk	23.20
	A, rms	16.40
Force Constant, Sinusoidal Drive (4,8)	N / A, pk	26.67
	lb / A, pk	6.00
	N / A, rms	37.72
	lb / A, rms	8.48
Motor Constant (2,4)	N / √W	10.29
	lb / √W	2.31
Resistance, 25 °C (line to line)	Ohms	6.4
Inductance (line to line)	mH	1.90
Thermal Resistance, 20 psi, 1.4 bar	°C / W	0.44
Thermal Resistance, No Cooling	°C / W	0.93
Maximum Bus Voltage	VDC	340

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. Values shown @ 100 °C rise above a 25 °C ambient temperature, with motor mounted to the specified aluminum heat sink
3. Peak force assumes correct rms current, consult Aerotech
4. Force Constant and Motor Constant specified at stall
5. All performance and electrical specifications +/- 10%
6. Maximum winding temperature is 125 °C
7. Ambient operating temperature range: 0 °C - 25 °C, consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated Apk; use torque constant in N-m / Apk when sizing

3.4. Load Capability

It is recommended that application loads be symmetrically distributed whenever possible (i.e., the payload should be centered on the stage table and the entire stage should be centered on the support structure). With the stage mounted vertical and the application load symmetrically distributed on the carriage, the maximum vertical load carrying capacity of ABL1500Z stages is 15.0 kg. If cantilevered or off-center loads are applied, refer to 3.4 and 3.4 to find the maximum allowable load. Figure 3-3 shows the orientation of “pitch” and “yaw” loading.

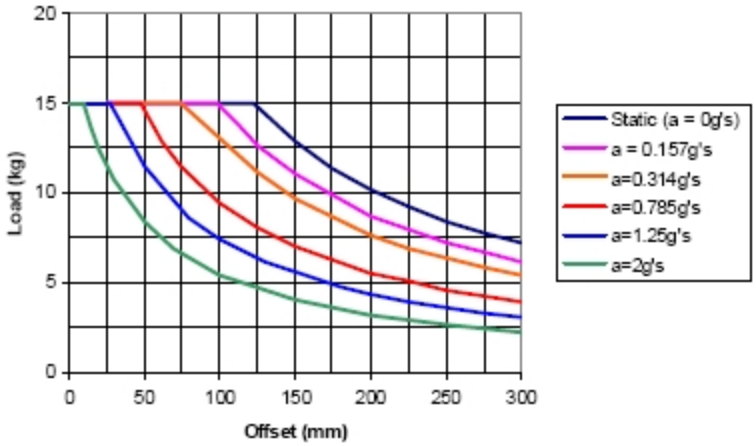


Figure 3-1: Cantilevered Load Capability (Pitch) for Various Peak Accelerations

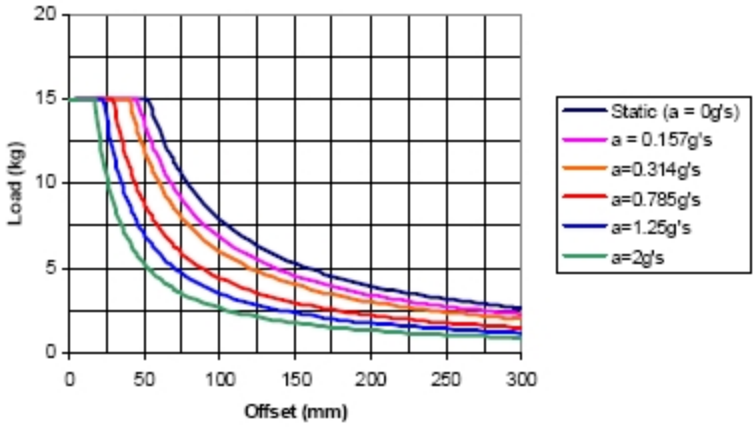


Figure 3-2: Offset Load Capability (Yaw) for Various Peak Applications

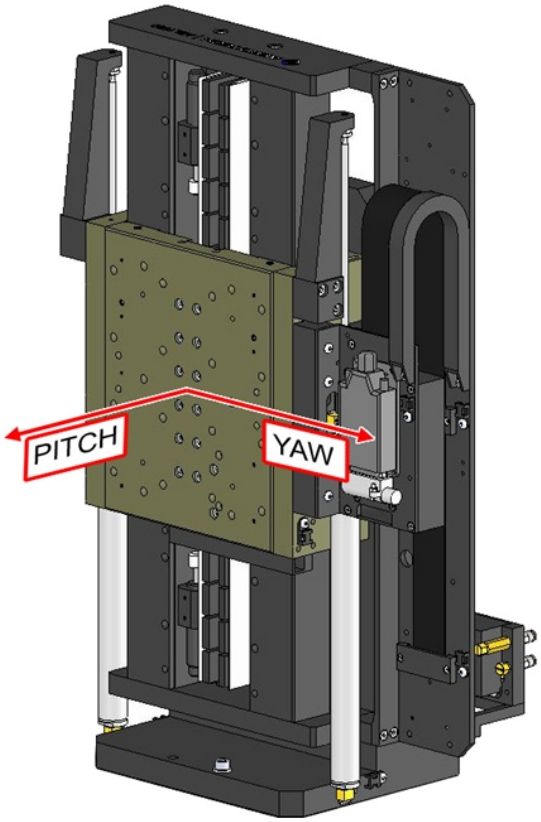


Figure 3-3: Cantilever and Offset Loading Diagram

3.5. End of Travel Limits

ABL1500Z series stages are provided with EOT (End of Travel) limits. These limits indicate to the motion controller when the stage has reached its maximum useable travel in each direction.

3.5.1. Limit Operation

The EOT limits are integral to the encoder feedback read head and integrated into the feedback connector. These outputs change state when the stage approaches its maximum travel distance and signals the motion controller. The ABL1500Z stage limits operate as normally-closed (N.C.) current sinking outputs.

If the stage is driven approximately 9.5 mm beyond the electrical limit, it will encounter a shock absorber. The shock absorber will attempt to slow the stage over an approximately 12.7 mm stroke before contacting the mechanical stop. Although the operating speed of the stage might be relatively slow, impacting the mechanical stop could cause damage to the stage.

3.5.2. Limit Switch Wiring

The ABL1500Z stage has open-collector EOT limit outputs. Since they are open-collector devices, they may be interfaced to 5-24 Volt logic inputs.

Assuming a N.C. limit configuration, as shown in the upper half of Figure 3-4 (JP2 set 1-2), the limit input to the controller is a logic 0 (typical 0.4 Volts @ 12.8 mA) when no EOT limit is present. When the EOT limit is activated, the switch (transistor) shuts off and the signal changes state to logic 1 (typically 4.8-5 Volts), because of the external user-supplied pull-up resistor. The limit switch operation for a N.O. limit configuration is the exact opposite as described above.

The upper half of Figure 3-4 also illustrates a current-sinking output (JP1 set 2-2). The lower half of Figure 3-4 illustrates a current-souring output (JP2 set 2-3).

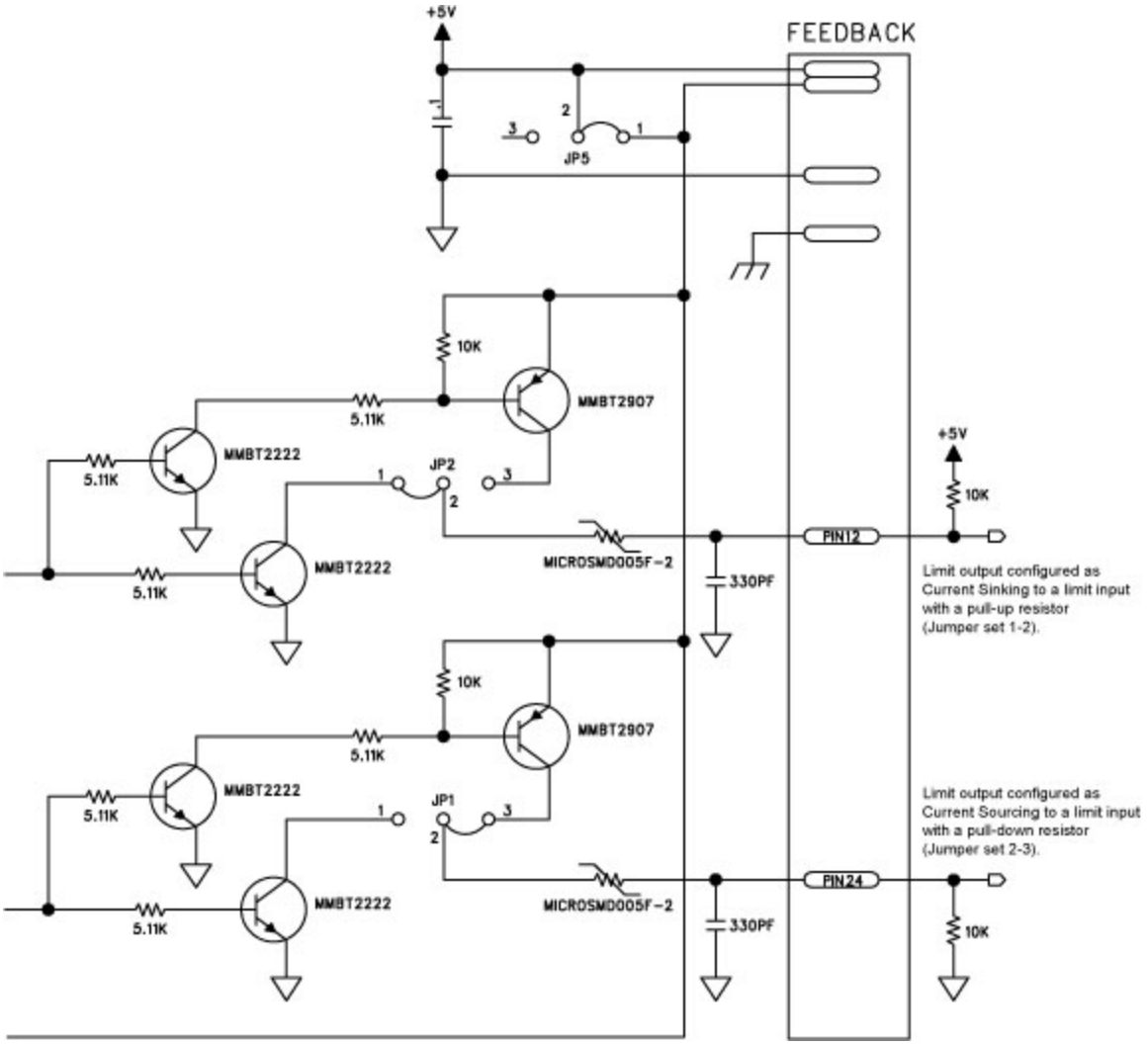


Figure 3-4: Current Sourcing or Current Sinking Limit Output Configuration

3.5.3. Limit Operation with the -LNAS and -Z-CMS Encoder Options

The limit signals provided by the encoder with the -LNAS and -Z-CMS encoder options are nonstandard. These two signals do not directly indicate end of travel limits. There are two TTL compatible open-collector signals, capable of driving 8mA. Table 3-5 describes these two signals.

Table 3-5: -LNAS and -Z-CMS Encoder Options Limit Signals

Signal	Internal Encoder Signal Name	Description
CCW/-LMT	L	EOT Limit indicator (non-directional)
CW/+LMT	H	Stage Directional Signal

As shown in Figure 3-5, if the CCW/-LMT signal is true, the CW/+LMT signal will indicate which end of travel limit is active.

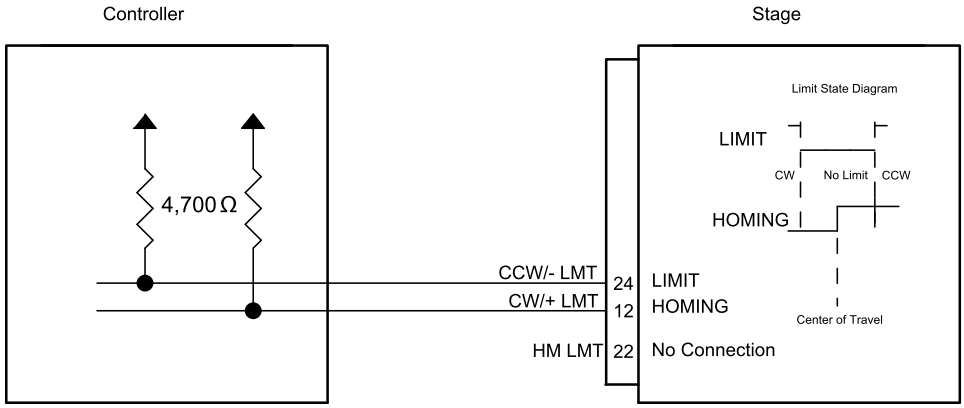
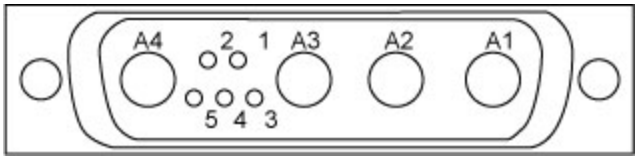


Figure 3-5: -LNAS and -Z-CMS Encoder Options Limit Wiring

3.6. Standard Motor Wiring

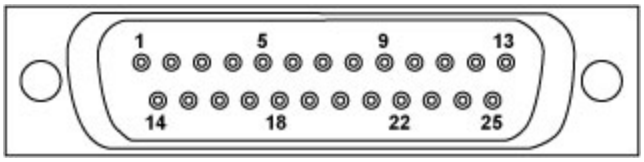
NOTE: If you are using your own cables to connect the stage, ensure that motor and ground wires can handle current higher than the continuous current listed in Table 3-4. The voltage rating of the wire insulation must be greater than the maximum bus voltage listed in Table 3-4.

Table 3-6: Motor Connector Pin Assignments



Pin	Description	Pin	Description
A1	MTR ØA	3	RESERVED
A2	MTR ØB	4	RESERVED
A3	MTR ØC	5	RESERVED
1	MTR SHLD	A4	FRM GND
2	RESERVED		

Table 3-7: Feedback Connector Pin Assignments



Pin	Description	Pin	Description
1	SIG SHLD	14	COS
2	THERM SW	15	COS-N
3	ENC +5V	16	LMT +5V
4	RESERVED	17	SIN
5	HB	18	SIN-N
6	MKR-N	19	RESERVED
7	MKR	20	LIMIT COMMON
8	RESERVED	21	ENCODER COMMON
9	RESERVED	22	RESERVED
10	HA	23	RESERVED
11	HC	24	-LMT
12	+LMT	25	RESERVED
13	RESERVED		

Table 3-8: Connector Wiring Pinout Descriptions

Pin Output	Description
+LMT	Active high signal indicating maximum travel produced by positive stage direction.
COS	Cosine. Incremental encoder output; either TTL line driven or amplified sine wave type signal.
COS-N	Incremental encoder output. Compliment of cos.
-LMT	Active high signal indicating stage maximum travel produced by negative stage direction.
ENC +5V	+5 V supply input for optical encoders. Typical requirement is 250 mA.
HA	Hall Effect A. Brushless motor commutation track output. TTL line driven signal with rotary motor.
HB	Hall Effect B. Brushless motor commutation track output. TTL line driven signal with rotary motor.
HC	Hall Effect C. Brushless motor commutation track output. TTL line driven signal with rotary motor.
LMT +5v	+ 5 V supply input for optical limit switch boards. Typical requirement is 50 mA.
MKR	Marker. Incremental encoder output pulse given once per revolution. Typically used for home reference cycle.
MKR-N	Incremental encoder output; either the compliment of Marker with a line driven, TTL type encoder or 2.5 V DC bias level with amplified sine wave type encoder.
SIN	Sine. Incremental encoder output; either TTL line driven or amplified sign wave type signal.
SIN-N	Incremental encoder output. Compliment of sin.
THERM SW	Positive lead for motor thermistor (to motion controller).
MTR ØA	Motor Phase A.
MTR ØB	Motor Phase B.
MTR ØC	Motor Phase C.
+5V	+5V supply.
LMT COM	Common ground to limit switch.
SIG SHLD	Signal shield connection.
RESERVED	Not used.
SIG COM	Signal common.

3.7. Vacuum Operation

The ABL1500Z is an air-bearing stage and is not compatible with operation in a vacuum environment. Contact Aerotech for alternate solutions.

Chapter 4: Maintenance

The ABL1500Z series stages are designed to be maintenance free positioning systems. Due to the non-contact air bearing design of both the stage and the counterbalance cylinders, there are no friction surfaces or dynamic seals to wear or require lubrication. However, it is important to clean the bearing surfaces and encoder strips to maintain the accuracy of the stage. This chapter will detail the cleaning process and specify recommended cleaning solvents.

NOTE: The bearing area must be kept free of foreign matter and moisture; otherwise, the performance and life expectancy of the stage will be reduced. See Section 2.6. for air requirements.

To minimize the possibility of bodily injury, confirm that all electrical power is disconnected prior to making any mechanical adjustments.

4.1. Service and Inspection Schedule

Aerotech recommends that the ABL1500Z be inspected once per month until a trend develops for the specific application and environment.

4.2. Cleaning and Lubrication

There are no elements on the ABL1500Z that require lubrication. Periodic cleaning to remove dust is recommended.

4.2.1. Recommended Cleaning Solvents

Before using a cleaning solvent on any part of the stage, it is recommended that clean, dry compressed air is used to blow away small particles and dust. All encoder surfaces and magnet tracks should be cleaned with isopropyl alcohol. Aluminum hardcoated metal surface may be cleaned with acetone. Acetone should not be used on magnet tracks because it could break down the epoxy that holds the magnets in place.

Table 4-1: Recommended Cleaning Solvents

Item	Recommended Cleaner
Encoders, Magnets	Isopropyl Alcohol
Hardcoated Aluminum	Acetone

4.2.2. Cleaning Process

The cleaning process is outlined in the steps that follow. It is recommended that all air bearing surfaces and encoder scales are cleaned often to prevent damage to the stage or decreased performance. The entire stage should be blown with clean, dry, compressed air often to prevent dust from building up in the linear motors, encoders, and air bearing surfaces.

In order to clean the entire length of the air bearing surfaces and encoder scales, it will be necessary to move the stage.

Strong rare-earth magnets are present in the linear motor magnet track. Loose metal objects (tools, watches, keys, etc.) may cause personal injury and/or damage to the equipment.

Moving the stage table without air supplied can cause permanent damage to the stage. Refer to Section 2.6. for more information about air requirements and installation.

Begin with the stage at one end of travel and remove power. Clean all accessible surfaces, being sure that the correct solvent is used on each surface (see Table 4-1). Once the cleaner has dried, move the stage by hand to the opposite end of travel. This should expose all previously covered surfaces. Repeat the cleaning process, and then restore power to the stage once all solvents have dried.

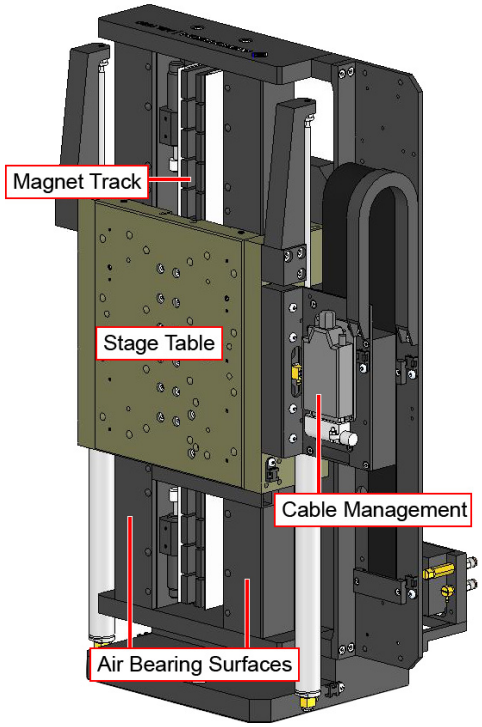


Figure 4-1: Air Bearing Surfaces and Encoder Scales Require Periodic Cleaning

To minimize the possibility of bodily injury, confirm that all electrical power is disconnected prior to making any mechanical adjustments.

Appendix A: Warranty and Field Service

Aerotech, Inc. warrants its products to be free from defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products that are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, where or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability or any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Laser Products

Aerotech, Inc. warrants its laser products to the original purchaser for a minimum period of one year from date of shipment. This warranty covers defects in workmanship and material and is voided for all laser power supplies, plasma tubes and laser systems subject to electrical or physical abuse, tampering (such as opening the housing or removal of the serial tag) or improper operation as determined by Aerotech. This warranty is also voided for failure to comply with Aerotech's return procedures.

Return Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within (30) days of shipment of incorrect materials. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. Any returned product(s) must be accompanied by a return authorization number. The return authorization number may be obtained by calling an Aerotech service center. Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than (30) days after the issuance of a return authorization number will be subject to review.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an airfreight return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Returned Product Non-warranty Determination

After Aerotech's examination, the buyer shall be notified of the repair cost. At such time, the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within (30) days of notification will result in the product(s) being returned as is, at the buyer's expense. Repair work is warranted for (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special service rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

On-site Non-warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

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Pittsburgh, PA
15238-2897

Phone: (412) 963-7470

Fax: (412) 963-7459

Appendix B: Technical Changes

Table B-1: Current Changes (1.02.00)

Section(s) Affected	General Information
Section 3.5.3.	Section added

Table B-2: Archived Changes

Revision	Section(s) Affected	General Information
1.00.00	--	New manual
1.01.00	Section 1.4.	Section added
1.01.00	Section 3.1.	Section added
1.01.00	Section 1.1.1.	Updated ordering information
1.01.00	Chapter 2: Installation, Section 2.1. , Section 2.3. , Section 2.5. , and Section 1.3.	Added safety information and warnings
1.01.00	Section 3.3.	Updated stage specifications
1.01.00	Section 3.3.	Added motor specifications
1.01.00	Section 3.6.	Added note about motor wire current and voltage requirements
1.01.00	Section 3.5.1.	Corrected mechanical stop warning

Index

Reader's Comments

ABL1500Z Series Stage Manual **P/N: EDS130, April 15, 2011** **Revision 1.02.00** Please answer the questions below and add any suggestions for improving this document.	

Is the manual:	Yes	No
Adequate to the subject		
Well organized		
Clearly presented		
Well illustrated		

How do you use this document in your job? Does it meet your needs? What improvements, if any, would you like to see? Please be specific or cite examples.

	Stage/Product Details		Name	
Model #			Title	
Serial #			Company Name	
Date Shipped			Address	
Customer Order #				
Aerotech Subsidiary Order #			Email	

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	Email:
	service@aerotech.com